



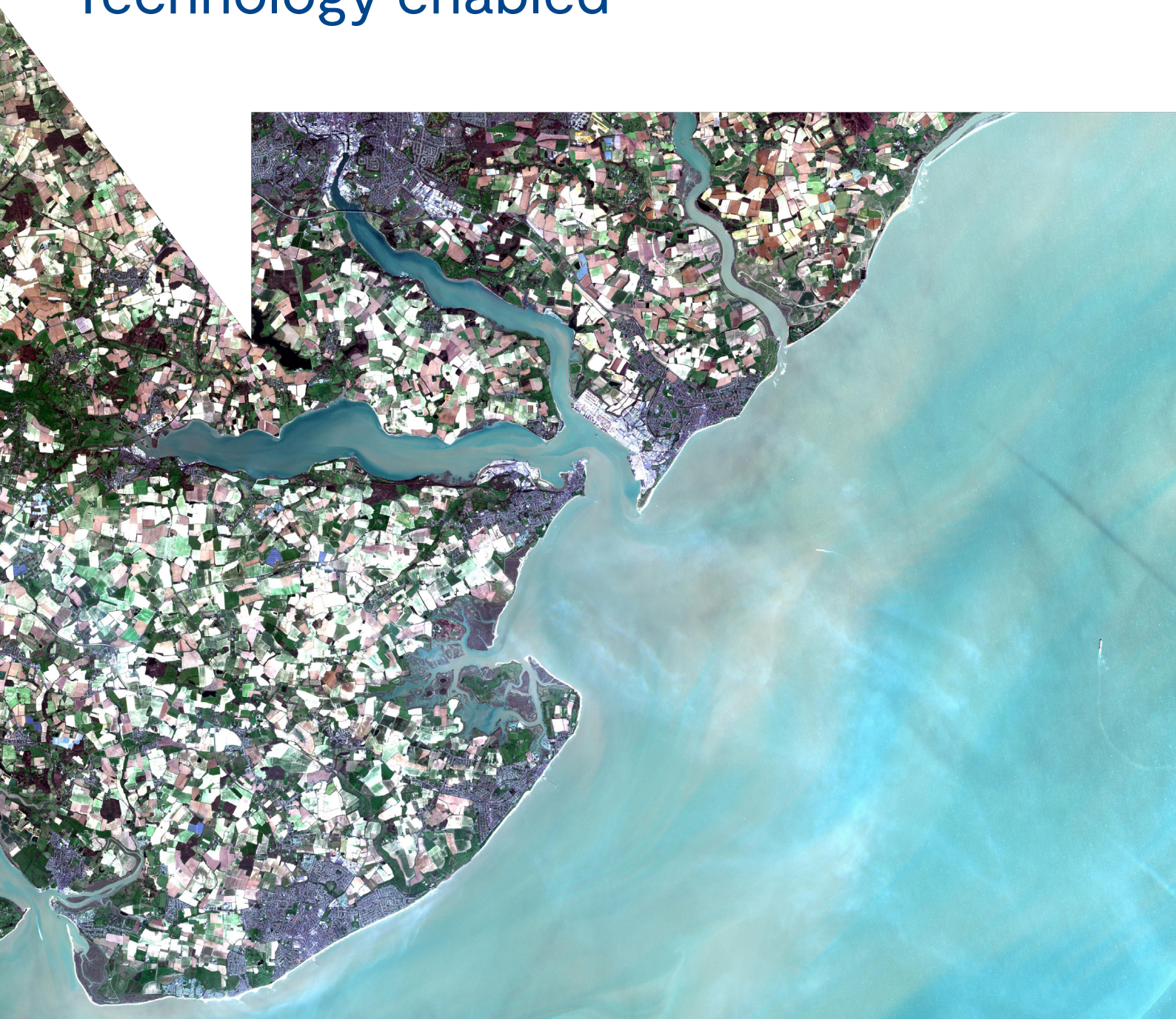
Science and
Technology
Facilities Council

RAL Space



RAL Space

Science driven
Technology enabled





Introduction

RAL Space is the UK's national space laboratory advancing the understanding of space and our environment for the benefit of all. Our activities and our facilities enable scientific research in disciplines such as climate science, space weather and astronomy. With over 60 years of experience in space programmes, we have had significant involvement in more than 210 instruments on missions to date.

We run some of the UK's most advanced space and science facilities and our experts work throughout the lifecycle of space missions. From leading concept studies for future spacecraft; developing bespoke scientific instrumentation; providing space test and calibration services; operating ground-stations to processing and analysing data.

We support UK academia through collaborations, services and technology development and partner the UK space industry through contract research and access to our world-leading facilities. We bring together ideas to make the UK space community stronger.

RAL Space is an integral part of the Science and Technology Facilities Council's Rutherford Appleton Laboratory and is the space hub for UK Research and Innovation. We employ more than 335 highly skilled staff in the heart of the Harwell Space Cluster in Oxfordshire and at the Chilbolton Observatory in Hampshire.

Why work with RAL Space

Access to science expertise

Our scientists undertake pure research in solar and heliospheric physics, in magnetospheric and ionospheric physics, in atmospheric and planetary physics, astronomy, plasma physics and space weather. Our research encompasses a wide range of interests, running in close harmony with our space hardware projects and involves collaboration with many university groups in the UK and abroad.

Access to technology

RAL Space has a number of internationally important technology groups, each specialising in a specific technology associated with cutting-edge space instrumentation. This expertise is backed by our extensive engineering capability which allows us to play a leading role in defining novel scientific instruments. Our experienced engineers use the latest tools to design and build space and ground-based instruments. We adopt an integrated approach and support projects throughout the full life cycle, from requirements analysis and conceptual design through to flight and commissioning.



Artists impression of the Solar Orbiter spacecraft passing in front of the Sun. Credit: ESA/ATG medialab



Engineers inspecting the calibration system for Meteosat Third Generation at RAL Space. Credit: RAL Space

Access to world class facilities

The facilities at RAL Space have been created to meet the comprehensive and exacting needs of our own projects and those of our customers and collaborators. They also provide capability for the need of the next generation of spacecraft and instruments. We offer many facilities from satellite testing and calibration to facilities and capabilities including precision development, laser spectroscopy and multilayer insulation. Our test facilities are capable of testing nanosats up to 7 tonne satellites.



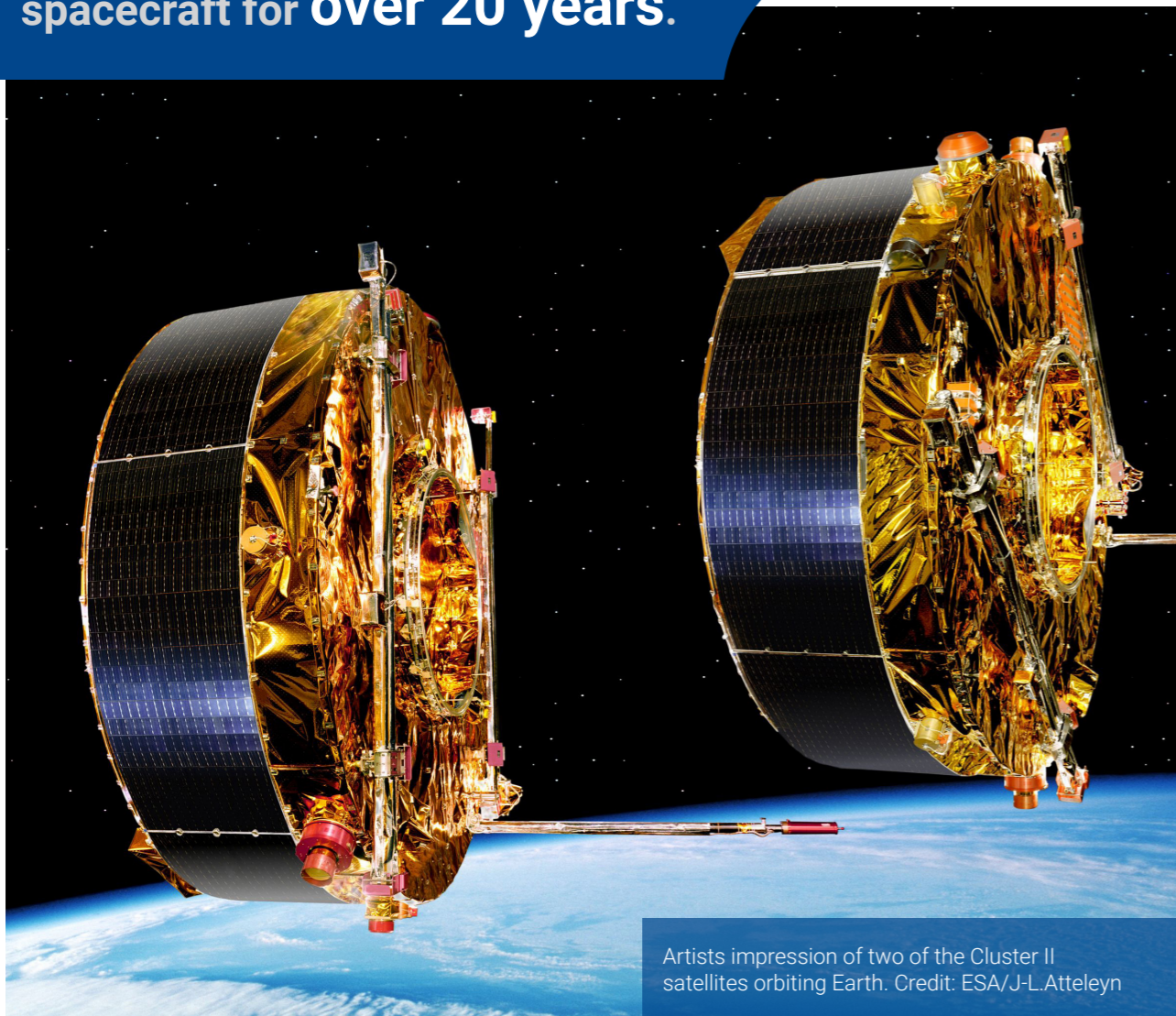
Large Space Test Chamber in the National Satellite Test Facility. Credit: RAL Space

Access to operational expertise

RAL Space has a proven track record, recognised internationally, in the areas of satellite mission planning and payload science operations, providing ground-station services and software for the precision control of a wide variety of telescope systems.



RAL Space have run the science operations for the four Cluster II spacecraft for over 20 years.



Artists impression of two of the Cluster II satellites orbiting Earth. Credit: ESA/J-L. Atteyln

Access to data services

RAL Space has considerable experience in the processing, analysis, and provision of scientific data. We are often involved in the early-stage processing of data from space instruments that we have built. We also produce multi-year global satellite data sets on atmospheric constituents for climate research.

RAL Space run long term data archives, managed by the Centre for Environmental Data Analysis (CEDA), for the environmental science community.

We work closely with scientists who are gathering data to ensure that those data are described in an unambiguous manner and properly archived so they can be used in decades to come.

Over 20 Petabytes of atmospheric and Earth observation data archived at our data centres.

JASMIN, data intensive supercomputer for environmental science. Credit: STFC RAL Space



Our areas of expertise

Earth observation

RAL Space contribute to and underpin UK and international programmes in environmental science by providing research expertise, services and facilities. We have expertise in remote sensing models, calibration activities, and characterising spectral properties of environmental components. Making observations of the land, sea and air from space allows scientists to monitor our environment, improve their models and so better understand our planet. Space instruments we have been involved in provide continuous global measurements over many years to provide information on both immediate and longer-term changes in the environment.

40 years of continuous measurements of Earth's surface temperature from ATSR and now SLSTR.

Crosby Beach, UK captured by Sentinel-2.
Credit: Copernicus data – processed by RAL Space

Solar physics and the near-Earth environment

RAL Space has a long heritage of solar space mission involvement mainly through the development and operation of spectroscopic instrumentation in the extreme-UV and X-ray wavelengths, but also in coronal and heliospheric imaging.

We develop ground and space-based instrumentation to study the near-Earth environment from the heliosphere to the Earth's ionosphere. We use observations of the solar atmosphere and solar wind to determine the Sun's plasma characteristics and track huge mass eruptions all the way from the Sun's corona to beyond the Earth's orbit. Our research in space weather is helping to understand and forecast the impacts of solar activity at the Earth.

RAL Space has over 90 years of involvement in continuous ionosonde measurements.



Magnetic loops in large active region of the Sun.
Credit: Solar Dynamics Observatory/NASA

Space debris and satellite tracking

With an ever-increasing number of satellite launches, including the advent of mega-constellations, there is an important requirement to track and manage objects in orbit around the Earth. This applies especially to Low Earth Orbit (300-2,000 km) which is the most congested region, but as far out as Geosynchronous orbit at 36,000 km which is used by many communications satellites. RAL Space uses optical and radar systems to track active satellites and space debris objects as well as providing data to support the modelling of space weather processes which affect satellite orbits.

The Chilbolton Observatory radar can detect and track objects with radar cross sections larger than 0.5m^2 in low Earth orbit out to 2000km.

25m radar antenna located at the Chilbolton Observatory. Credit: STFC RAL Space

Astronomy

RAL Space supports astronomers around the world using instruments in space and on the ground, with a wide range of expertise in design, building, testing and calibration. We also carry out leading astronomical research using data from these and other instruments to further our understanding of the universe, galaxies and the formation of stars and planets.

RAL Space is at the heart of the UK's infrared to microwave astronomy programme. We are involved in the James Webb Space Telescope and also lead the technical team for the Ariel space mission to characterise planets outside our solar system, known as exoplanets. At longer radio wavelengths we are involved in the operation and development of the LOFAR radio telescope, and the Square Kilometre Array Observatory, which when operational, will be the largest scientific facility in the history of humankind.

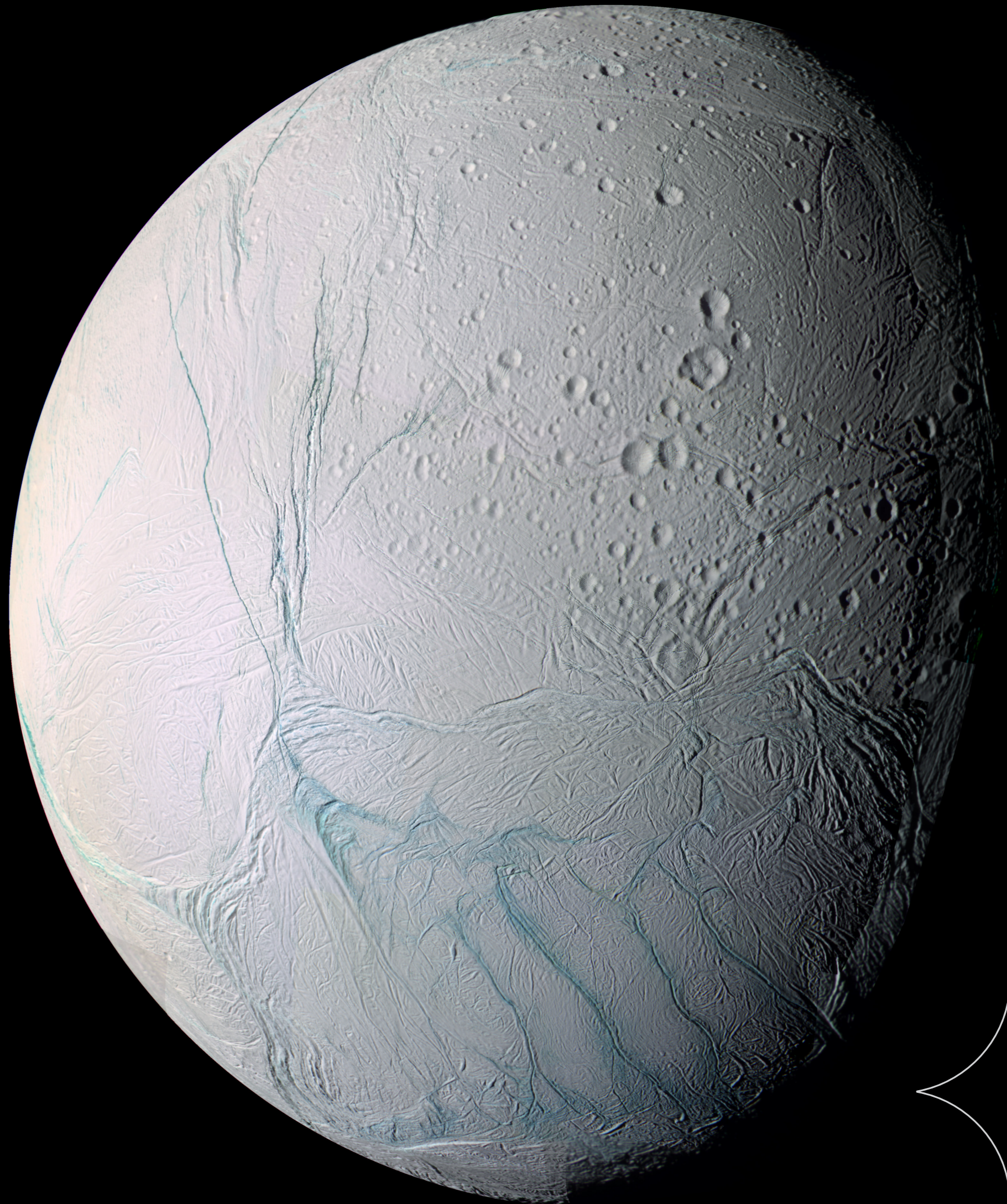
The instruments and spacecraft designed and developed by RAL Space cover **13.7 billion years** of cosmic history from the present day right back to the Big Bang.

The Andromeda galaxy. The bright orange lanes in the image represent the dust and gas heated by generations of young stars as observed by the Herschel SPIRE instrument. Credit: ESA/Herschel/SPIRE/PACS; ESA/XMM

Planetary Science

RAL Space has a strong instrument programme, including missions to all the inner solar system planets, the Moon, as well as comets and the Saturnian system. This includes remote sensing instruments aboard orbiters as well as instruments aboard rovers. This scientific area runs in parallel with our involvement on space missions that study exoplanets in other stellar systems. These missions continue to yield a wealth of science and help us to understand the Earth and the solar system as well as the planetary systems of other stars.

The Ariel space telescope will study the atmospheres of around **1000 planets** outside our solar system, known as exoplanets.



False colour view of Enceladus taken by the Cassini spacecraft. Credit: NASA/JPL/Space Science Institute



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